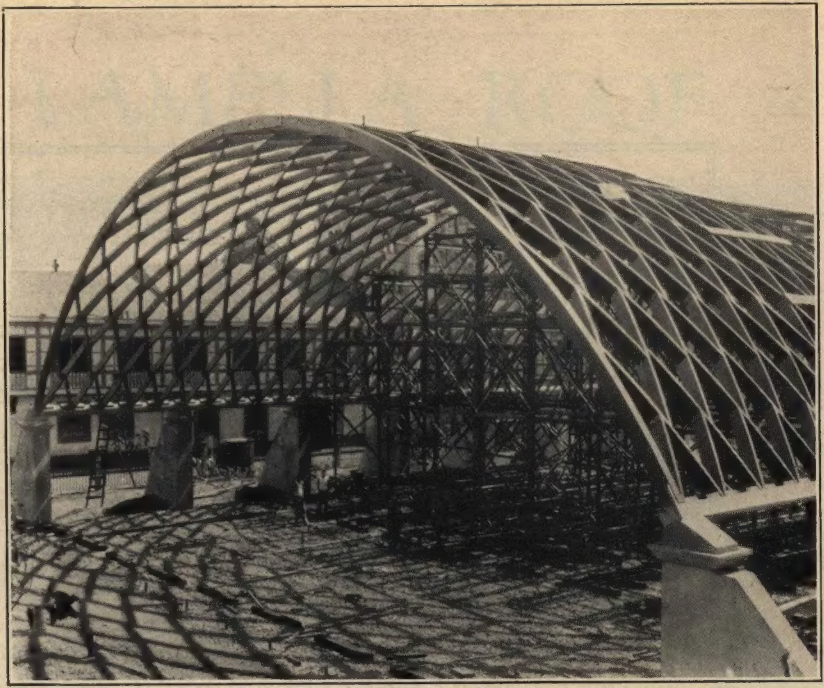
LUMBER AND ITS UTILIZATION



THE LAMELLA ROOF

NATIONAL LUMBER MANUFACTURERS ASSOCIATION

VOL·IV·CH·12 CONSTRUCTION INFORMATION SERIES

(REVISED EDITION, 1931)

PREFACE

THIS bulletin is one of a series on lumber construction being prepared by the National Lumber Manufacturers Association for the information of architects, engineers, and builders. Information is here presented on the principles underlying the design of the Lamella Roof, and it is intended to facilitate the preparation of tentative building plans premised on the use of "lamellas." Its construction is visualized sufficiently to enable those who have not seen the roof, or pictures of it, to avail themselves of its unique possibilities which have made its field of application very wide and diversified.

The general adoption and its increasing popularity among architects and engineers, as has been evidenced in the last seven years, is significant that its application and principles are sound. Work now carried on by the Lamella Corporation in conjunction with its field offices in developing its use and furthering new development is continuing in step with modern construction methods.

For those requiring more detailed and specific information, especially final plans and specifications, on page 26 are given the names and addresses of the various licensees of the Lamella Roof Syndicate, Inc.

The co-operation and assistance of the Lamella Roof Syndicate, Inc., of New York City, and the branch offices of the organization have been utilized in preparing this bulletin. The following text has been reviewed by its Chief Engineer.

Further information on this subject may be found in Sweet's "Architectural Catalogue."

NATIONAL LUMBER MANUFACTURERS ASSOCIATION, INC.

THE LAMELLA ROOF

Fig. 1. Playland Casino, Rye Beach, N. Y.

DUE to the organization of industry in larger units, mass production, and the growing use of conveyors in manufacturing assembly, there is an increasing demand for large unobstructed floor areas at minimum unit costs. Traveling cranes and the natural flow of materials in manufacturing processes make such arrangements essential and accentuate the tendency toward the one-story structure in industrial buildings, located in outlying, less densely populated sections.

At the same time, social and recreational requirements and transportation developments have brought about a demand in other fields for similar accommodations. The field for roof spans supported only at the walls includes such structures as cotton compresses and storage warehouses, garages, auditoriums, gymnasiums, skating rinks, armories and recreation halls, wharf and pier structures, airplane hangers* and large barns.

While the last item covers a field not yet generally developed, the barn is particularly suited to the application of the lamella roof on account of its adaptability to high arched roofs and the possibility of high steep sloping walls, especially if the three-hinged arch is used with the spring line at or near the ground.

Lamella roof construction may take the form of a two- or three-hinged arch, the horizontal thrust being absorbed by tie-rods, or buttresses carrying it to the foundations. Its principal advantage is the clear uninterrupted span it affords from side to side of the enclosure. On account also of its low cost, simplicity and ease of erection and light weight, this novel type of roof construction has already found wide use.

The lamella roof had its origin in Germany, being invented by a German building commissioner to meet local building requirements for wide, uninterrupted floor areas.

*For more information in this connection see National Lumber Mfrs. Assn. bulletin "Airplane Hanger Construction."

The lamella design finally evolved has had considerable application in other countries as well as Germany. It was first introduced to this country in 1925 and patents were taken out by the Lamella Roof Syndicate, Inc., a corporation whose offices are now at 45 West 45th Street, New York City. Since that time a large number of branches have been established throughout the United States and Canada. For convenience of the reader they are listed on page 26. The regional offices promoting lamella construction are independent of the parent organization, except insofar as they are licensed under the American patents. Problems of design may be referred either to the New York office or to the nearest branch office.

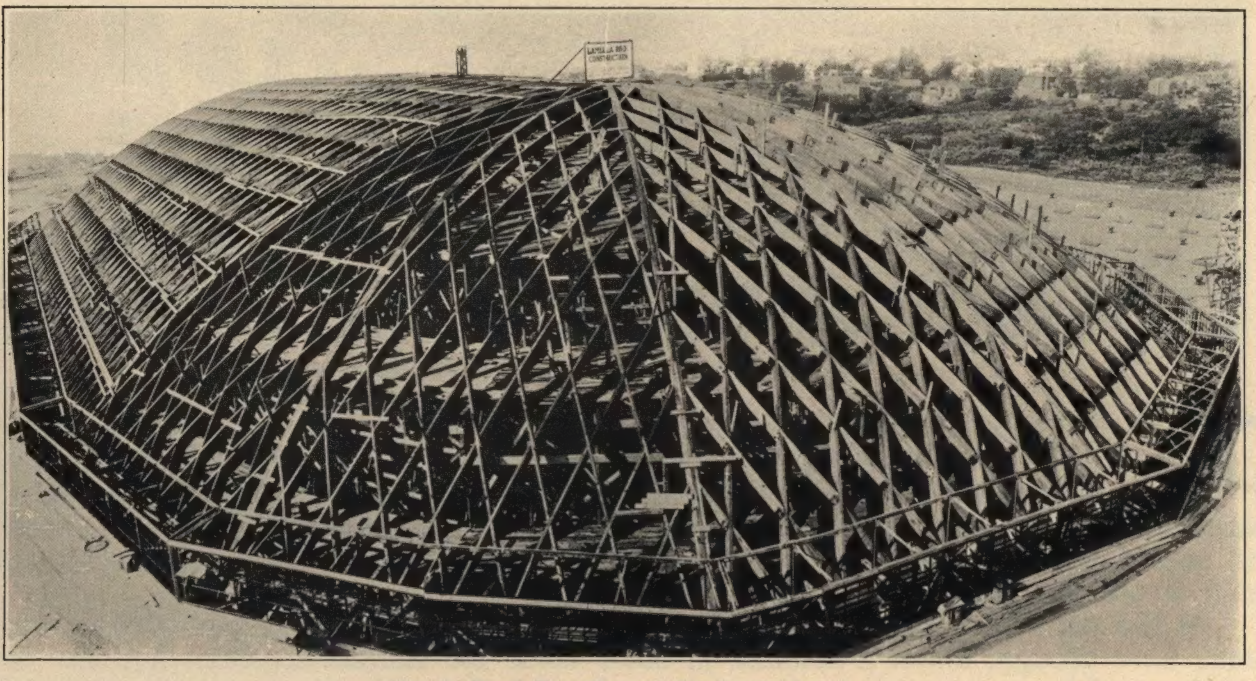


Fig. 2. Roof Framing of St. Louis Arena.

Because of the increasing demand for large unobstructed areas under roofs for industrial buildings and places of public gathering, lamella arch construction has readily been accepted by the architect and the engineer as a most satisfactory solution. Since its introduction into the United States, it has demonstrated such a combination of desirable qualities for certain types of buildings that it deserves the attention of every architect and builder.

Appearance

Lamella roof framing provides free spans of great width at relatively low cost. Clear spans up to 200 feet are feasible, and the graceful arch of the roof adds much to the interior and exterior beauty of the building.

The appearance is best illustrated by the photographs of a number of installations on the following pages. The structural elements of the lamella roof are decorative in themselves.

The unobstructed areas and head room also lend themselves well to simple yet effective decoration. This feature has been especially valuable in the design of churches, clubs, lodges, and ballrooms.

A number of architects have emphasized the effect of the lamella pattern by rough surfacing and staining the lamellas, while others have specified selected material and special dressing to emphasize the textural beauties of wood. Building board or plywood has also been used as background and the lamellas and panels have then been painted and decorated. Thus a great variety of pleasing effects may be developed. The exterior of a building using a lamella roof structure also may be readily adapted to meet the requirements of different architectural styles.

Ventilation and Distribution of Light

With the arched lamella roof, ventilation and distribution of light are so easily provided that the problem is almost negligible. The large volume of free, unobstructed space in arch con-

Fig. 3. Modernistic Treatment of Lamella Arch in the Central Park Casino, Manhattan, New York. Joseph Urban, Architect.

structed buildings allows the natural convection flow of enormous volumes of air, and a sufficiency of fresh air is always provided. By placing heaters in the path of these currents the heating of the building in winter becomes a relatively simple problem. For lighting, large areas of sheathing may be omitted at a number of places in the roof without any material decrease in structural strength, thereby admitting sufficient natural lighting during the day-light hours. The freedom of the span from shadow causing members makes the use of a simple lighting system easy and economical.

Acoustics

While the unbroken curve of the roof makes it an ideal reflector, the broken ceiling surface at the same time eliminates any confusing reverberation or harshness of tone. The acoustical effect is best described in the Architectural Record which commenting on a lamella building states that "The domed ceiling of the pavilion contributes to the airiness of this room, maintained by the delicacy of its lighting and decorations. Acoustically, the pavilion is a sensation . . . no echoing surfaces, owing to the broken ceiling, and the wood construction seems to vibrate like a cello."

The importance of good acoustical qualities cannot be overstressed in any building where public gatherings are to be held and particularly where electrical amplification may be desired.

Heating Cost and Insulation

The common conception that the amount of heat units required to maintain the temperature of a room is determined principally by its cubical contents is not correct. A room perfectly insulated would, regardless of its cubical contents, maintain its temperatures without being heated. Therefore, it is generally accepted by heating and ventilating engineers that the insulation value of the enclosing roof and walls determines the amount of heat necessary for comfort in a building.

The insulation value of a lamella roof is equivalent to that of truss and rafter construction. This can be materially increased if desired by the use of any of the commercial insulating materials which are easily and cheaply applied over lamella construction or in the spaces between the framing members.

Fire Resisting Qualities

A common though erroneous understanding is that steel is fireproof while wood is not. Steel is incombustible, but not fire resistant unless protected on all surfaces by two inches and more of fireproofing materials adequate to insulate it from fire temperatures. Without such protection steel framing will melt and collapse under comparatively low fire temperatures.

Heavy plank of minimum thickness of 4 inches to 6 inches, while it smolders when exposed to fire, does not readily give way. It takes a considerable time before the charring can materially weaken the structure and a fire may usually be extinguished before serious damage has resulted. Construction of this type, which weakens only slowly under fire exposure, takes fire insurance

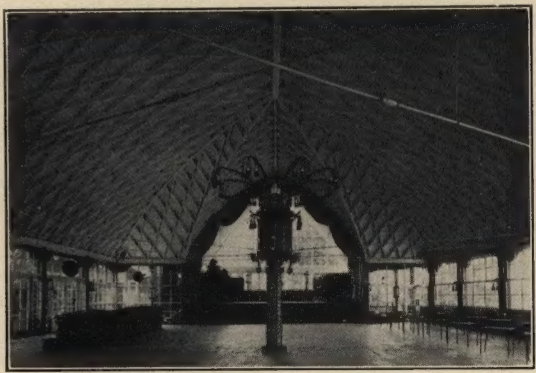


Fig. 4. Los Angeles Breakfast Club Auditorium.

rates second only to truly fireproofed construction. Lamella roofs have been built using timbers 4 inches and 6 inches thick and have had the benefit of these low fire insurance rates.

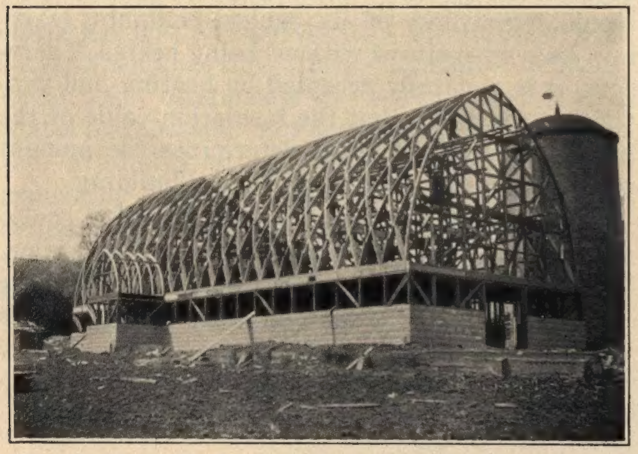


Fig. 5. Barn, Rochester, Minn. Span 34 feet, length 84 feet.

The minimum thickness of lumber used for small spans is 2 inches. With this thickness the fire insurance rates are the same as those for similar roofs carried on unprotected steel trusses. In a number of instances the rates are slightly less inasmuch as lamella construction is free from certain penalties which are placed upon other types of roof construction. The character of the roof, eliminating supporting members and arched high above the floor, protects it from early damage by fire. A hole may be burned through the roof at any place without causing collapse of the structure since the loads are then redistributed to less damaged timbers around the opening.

All parts of the roof are visible and accessible to the firemen. There is no danger of burning masses breaking down and carrying other parts of the structure with them. The roof can be conveniently and effectively sprinklered, using uniform maximum sprinkler head spacing.

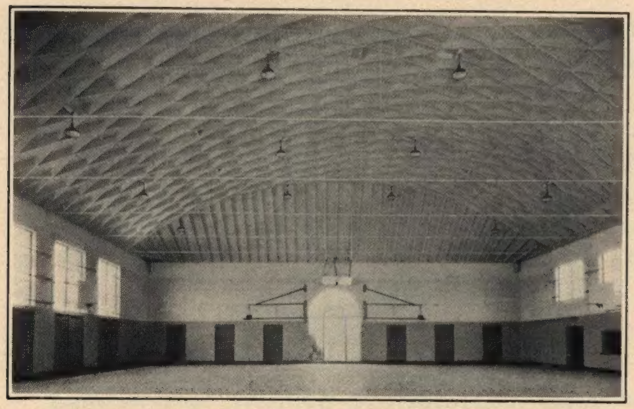


Fig. 6. Typical Interior of Modern Gymnasium

It is customary practice for city building codes to permit relaxation in fire-proofing for steel roof members or trusses over 20 or 25 feet from the floor, and if this can safely be done with steel it is obvious that lumber, being less quickly weakened by high temperatures, can be used with confidence at these heights. The lamella roof of moderate span can be confidently expected to remain in position under attack of fire as long or longer than roofs supported by unprotected steel. Its superiority increases as wider spans and larger timbers are utilized.

Fig. 7. Great Atlantic and Pacific Tea Company Store, Los Angeles, Calif.
Similar Stores Were Built in a Number of Other Cities.

Wind Resisting Qualities

The lamella network forms a curved wind truss, spanning from gable wall to gable wall. It therefore contributes materially to bracing the entire building laterally. Due to the curvature, it diverts rather than blocks the wind.

The closely spaced timbers permit of frequent and effective anchorage of the roof to the side walls. As all connections are bolted it offers a high-resistance against excess interior pressure due to winds or other causes.

Of the hundreds of lamella roofs in this country, about twenty-five or more were located in the path of the Florida hurricanes of 1926, 1928, and

Fig. 8. University of Oregon Gymnasium at Eugene, Oregon, under construction, showing barrel-like surface of mutually braced members. Size of this roof 110 feet x 162 feet.

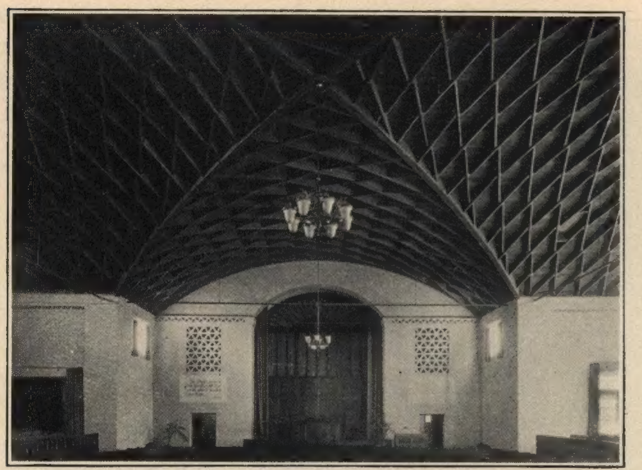


Fig. 9. Groined Roof of Twenty-Sixth Church of Christ, Scientist. Meyer and Holler, Architects.

1929 and the St. Louis hurricane of 1927. With the exception of two instances in 1926 where the entire building collapsed, no damage was done. The roofs did not even leak as a result of the storm.

Shrinkage

Shrinkage in wood occurs principally across the grain. Shrinkage along the grain is relatively small. Because the lamellas are arranged so that their fibres run with the span of the roof, the possible settlement due to shrinkage is reduced to minor consideration.

Shrinkage also depends on the moisture content. Therefore the material for lamellas is selected from dry stock. Units are subject to additional drying by repeated restocking during manufacture and during transport to building site and assembly. As a final precaution, lamella roofs are erected with an initial camber.

Cost

While cost is one of the most important considerations influencing the architect or owner as to the type of roof structure he will use, it is difficult to make definite cost estimates unless all considerations influencing design and construction are known. In other words, it is necessary to know exactly what is required, and where, when, and under what conditions the roof structure is to be built before this question can be answered. Conditions influencing costs vary from month to month and in different degrees for different localities so that today's price may be a poor guide tomorrow.

In general a lamella roof costs more than a wood truss roof but appreciably less than one of steel truss construction.

Material and Labor Locally Available

Material for the lamella roof is furnished by local lumber yards and cut by local woodworking shops. Highly specialized labor is not necessary which simplifies construction by local labor, a desirable feature. Buildings of this type divert a minimum of funds from local interests.

Speed of Erection

Perhaps one of the noteworthy features of lamella construction is its ease and rapidity of erection. Because of the simplicity of design, it is feasible to erect the arches without the use of expensive construction plant, which is an important factor in reducing construction costs.

Inasmuch as the material is easily procurable out of local stock, erection can be started with the least possible loss of time. The actual process of erection consists merely of the assembly of precut units on a light scaffolding.

Design

It is not practical, in a brief bulletin of this kind, to present sufficient information for a complete discussion of design. It is feasible only to place before the architect such simple underlying calculations as will enable him to determine the main characteristics of his building, the size and spacing of piers, walls or buttresses, and the amount of room required for them.

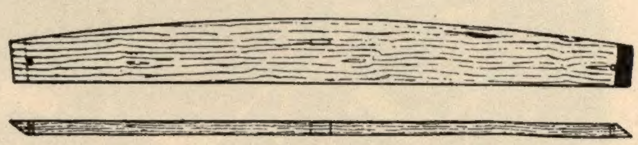


Fig. 10. Typical lamella. Note angular cuts, bolt holes, and circular cut of top to conform with roof curvature

The design of the lamella roof makes ingenious and interesting use of two simple principles; namely, the arch and the net work. The roof is made up of relatively short timbers called "lamellas", varying in section from 2" x 8" to 6" x 24" and in length from 8 to 20 feet, depending on the requirements (Fig. 10). They are bolted together (Fig. 11), forming the net work of framing timbers.

For spans up to 100 feet and more the units are bolted together in a manner called the 'Common Joint'. See figure below.

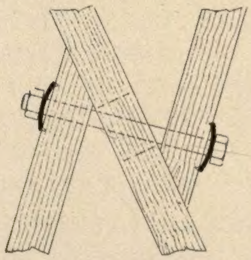


Fig. 11. Common joint method of bolting lamellas.

In case of large spans where bending moments of considerable amounts are set up at the bolting points of the respective lamellas, a special type of connection is used which is illustrated in Figure 12.

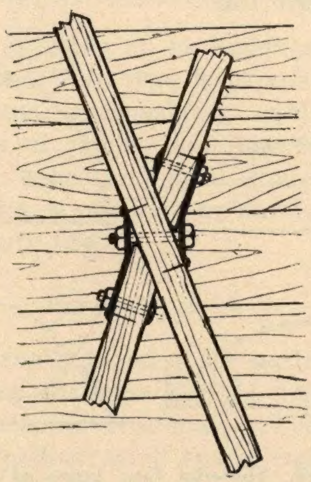


Fig. 12. Special joint method of bolting lamellas for larger spans or heavier loadings.

This method places the axis of the cut lamellas in line with each other and reduces the reactions at the connection to simple compression. This net work is not unlike that of diamond mesh expanded metal lath, except on a much larger scale.

Once the span of the roof proper is decided upon, the rise of the arch above the spring line must be determined, bearing in mind, of course, that the smaller the rise the greater the thrust, but the lower the cost of the roof itself. Good practice dictates a rise of about one-sixth, and in exceptional cases even one-seventh, of the span for the flat arch or the tie rod type. For the bent or buttress type a greater rise is advisable; from one-fifth to one-fourth is considered sufficient.

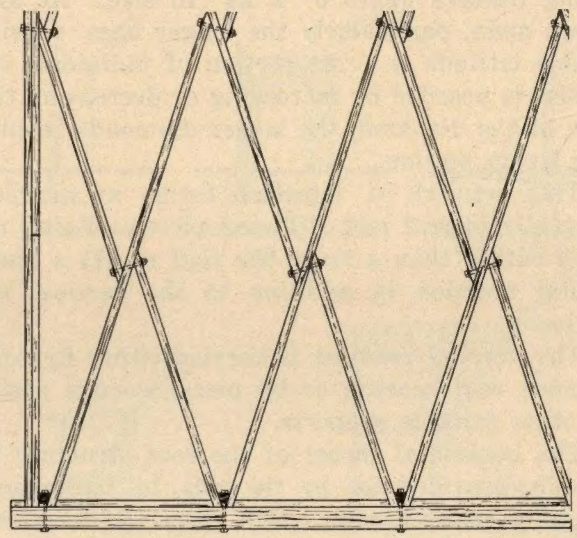


Fig. 13. Showing manner in which lamellas are bolted together to form network.

Having determined the span and rise, the next step is to determine the size of the lamellas. Tables have been prepared by the lamella companies giving the lengths and cross sections needed for the various spans and rises. Due to lack of space these tables are not included in this discussion, and while it is desirable to collaborate with the Lamella representatives before final

Fig. 14. Exterior of Twenty-Sixth Church of Christ Scientist, Los Angeles. Meyer & Holler, Architects.

plans are prepared, this is not necessary in developing preliminary sketches. For small spans

2″ x 8″ sections are sufficient. As the span or size of the diamond mesh is increased the lamella sizes increase up to 4″ x 18″ for spans of 165 feet. A few larger roof spans have been designed using timbers up to 6″ x 24″ in size. At any given span, particularly the longer ones, considerable latitude in cross section of individual lamellas is possible by increasing or decreasing the size of the diamond, the larger diamonds requiring larger section.

This network of lamellas forms an arch of mutually braced and stiffened pieces. Being an arch rather than a truss the roof exerts a horizontal reaction in addition to the vertical reaction.

The vertical reaction is carried either by continuous wall bearing or by piers, wooden posts, or other suitable supports.

The horizontal thrust of the roof structure is usually provided for by tie rods, by buttresses, piers, or framed bents which carry the reactions down to the footing.

Lamella design computations are usually based upon a snow or live load of 30 lbs. (unless other live loads are required by local building codes) and an average dead load of 10 lbs. per square foot, including the weight of the lamella roof proper, 1″ sheathing, and composition roofing. Good-practice with regard to snow or other live loads will vary in different parts of the country. By assuming dead and live loads proper for the design and locality, it is possible to determine the weight of the roof and so the size and spacing of supports necessary to carry the vertical component at the base of the arch.

The horizontal thrust may be determined by the following formula:

$$T = \frac{(L + l)\, S^2 D}{8R} \text{ where}$$

T=thrust in pounds.
L=live load in pounds per sq. ft.
l=dead load in pounds per sq. ft.
S=span of building in feet.
D=distance between ties in feet.
R=rise of arch in feet.

If tie rods are used, the tie rod area in inches is determined by dividing the thrust by the allowable tensile stress for steel of 18,000 pounds per square inch. If buttresses or bents are used, they are to be designed for the resultant of the vertical reaction and the horizontal thrust.

There are four principal types of roofs as described below.

Tied Segmental Arch

The thrust is taken up by tie rods. This method is used largely for garages, factories and commercial buildings occupying full lot area and where wide spans with good light and ventilation are essential. The rise is one-sixth, or in exceptional cases one-seventh, of the span.

These steel ties may be protected with fireproof wood, magnesia, pipe covering, or other fire resistant material. Steel weakens and loses strength under fire temperatures, and the result of fire weakening the steel rods can be compared to what happens if someone cuts the bow-string of an archer's bow. The arch would tend to spring into a horizontal plane, and unless the walls were sufficiently strong to absorb this force, it is probable that they would be forced out and the roof collapse. This method of arch support is illustrated in figure 15a.

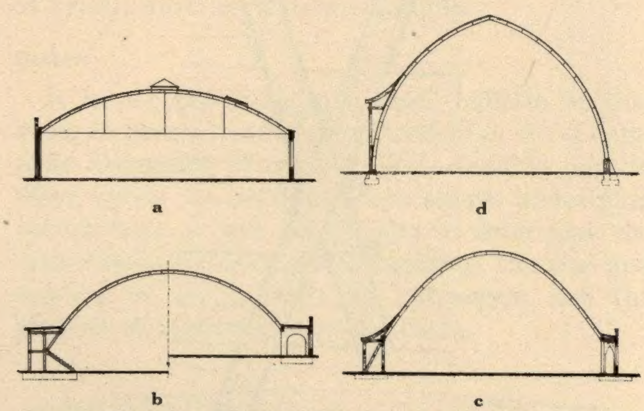


Fig. 15. Showing four types of arches.

The thrust of arch members between the ties, which are usually spaced from 12 to 20 feet, is distributed to the tie points by truss action of sill plates between these points in the combination with the adjacent lamellas. When tied together in this manner, such a roof is entirely self-sustaining and needs only wall or column supports sufficient to carry the weight of the roof. It should, of course, be properly anchored to resist wind action. It has generally been found desirable to carry the roof on piers just inside the walls as indicated in Figure 28 of the Triangle Investment Corporation's Garage, leaving the sill free between ties or bents.

Fig. 16. This picture shows clearly how bents may be used to carry the roof and suggests how the wing space may be utilized for storage or other purposes. Note diagonal member designed to take the direct thrust.

Buttress Segmental Arch

The thrust is taken up by buttresses, concrete piers or bents. This type is especially suitable for auditoriums, gymnasiums, exhibitions and various kinds of public buildings where unobstructed clear space and good acoustics are desired. The rise is one-fifth or one-fourth of the span. See figure 15b.

Parabolic Arch

Thrust is usually taken up by buttresses, bents or the like and the type is used principally for theatres, casinos, indoor arenas, and similar structures, where unobstructed space, combined with high rise, are the determining factors in design. The rise is one-fourth or one-third of the span. Figure 15c illustrates this type.

Gothic Arch

The thrust is taken up directly by the foundations, floor or buttresses. This type is especially suitable for churches, clubhouses and upper stories of residences; also for warehouses and barns where merchandise, such as grain and hay, are stored in bulk. The rise is about one-half of the span or greater. See figure 15d.

All of the above four types may be curved down at the ends, thereby forming a full cloistered structure of four or more sides. All types may be varied and combined to suit almost any requirement in shape or size.

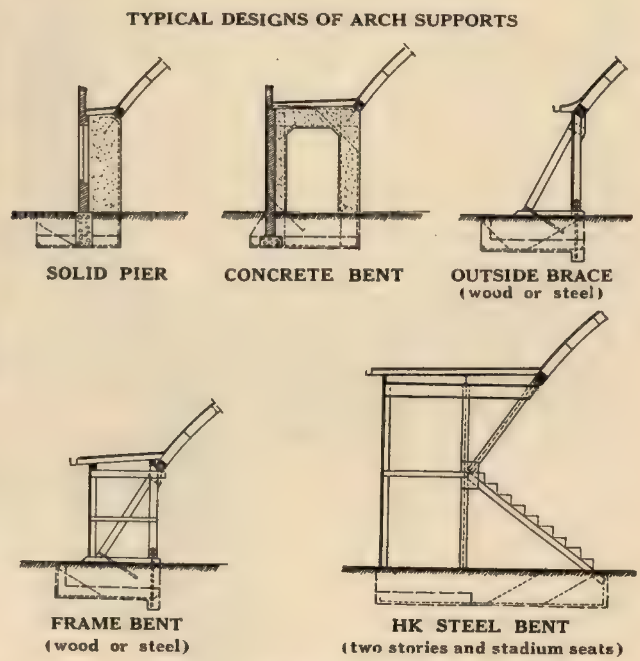


Fig. 17. Various methods of absorbing thrust, thus eliminating tie-rods and permitting unobstructed vision from floor to roof. This method usually makes possible the reduction of wall heights.

Roof Contours

There are three main arrangements possible for the lamella roof. These arrangements with their variations and combinations give ample leeway in design to meet any roof contour desired. They are shown below.

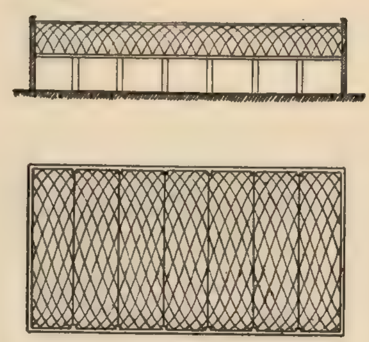


Fig. 18. Continuous Lamella roof.

(a) The "Continuous" lamella roof (Fig. 18) in which the cylindrical surface is carried from end to end of the building and the semi-circular end segments abutt against the end parapets of the building.

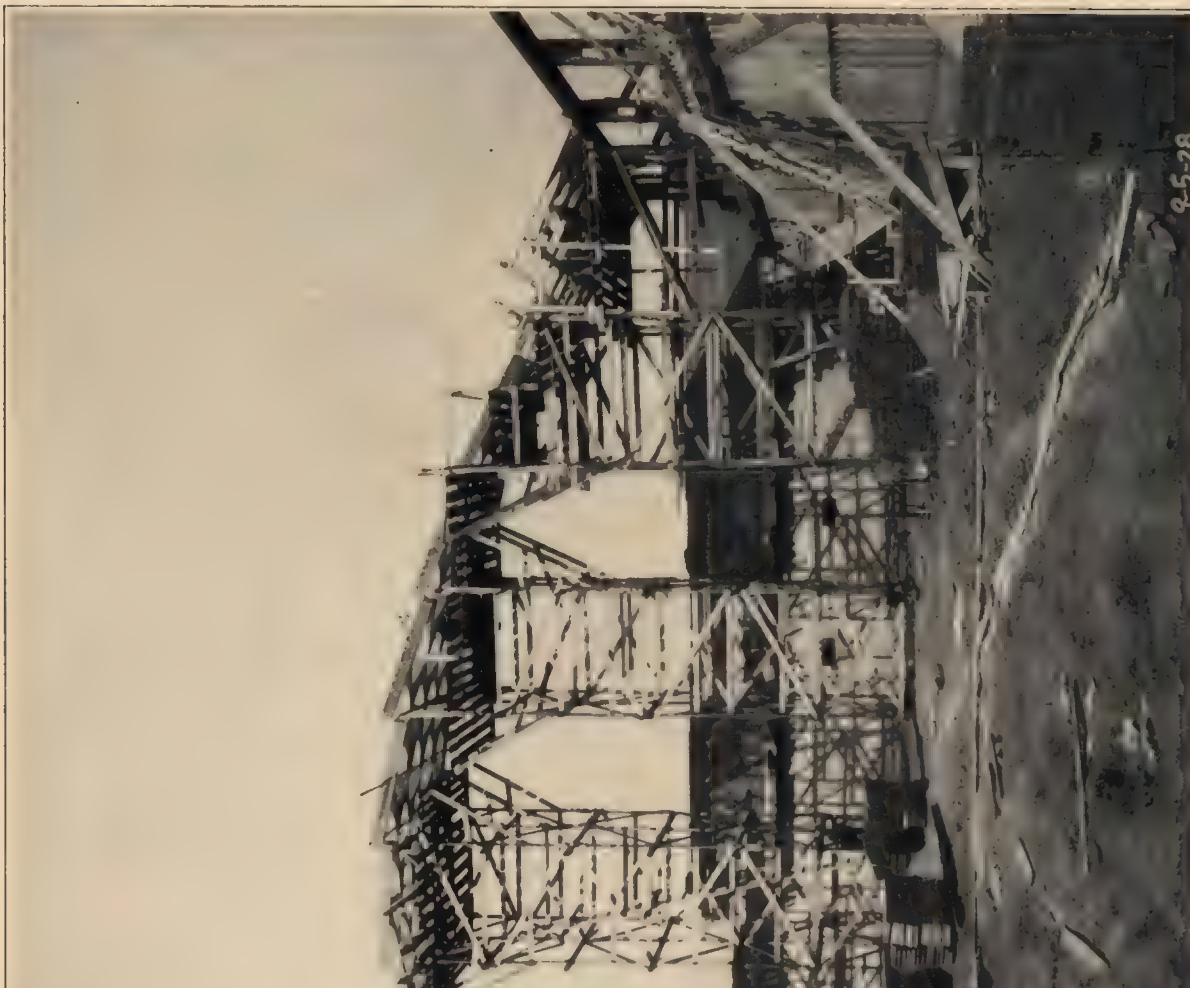


Fig. 19. Skating Arena at Fort Erie, Ontario, under construction—138 feet x 210 feet. Spring line 27 feet, rise of arch 23 feet 4 inches, lamellas 3 inches x 16 inches by 13 feet. Note that one bay of lamellas has been completed and scaffold moved to the next bay which has just been started at both sides.

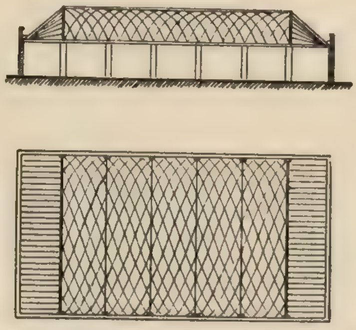


Fig. 20. Lamella with sloped rafters.

(b) The Lamella with sloped rafters (Fig. 20) is the same as the "Continuous" lamella roof, except that the cylindrical portion stops 15 or 20 feet from either end and this space covered by simple rafters which give a warped surface of varying slope as indicated.

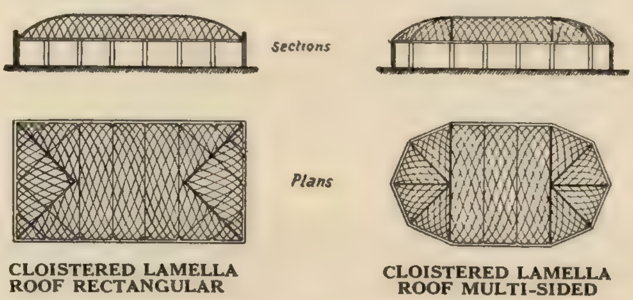


Fig. 21. Two examples of the Cloistered type.

(c) The "Cloistered" roof, which corresponds to the ordinary hip or pyramid roof such as is common in house construction (Fig. 21). Possible modifications of this type are also illustrated in these diagrams and in pictures elsewhere.

Fig. 22. Church of Our Lady of Mount Carmel, Rochester, N. Y.

Concentrated Loads

The lamella roof is not designated nor intended for support of concentrated loads. They may be provided for to a moderate extent, however, by the introduction of diagonally braced girders, made up in the following fashion (Fig. 23). A group of three 2 x 6s or 2 x 8s spiked together is arranged on top of the roof to run parallel to the axis of the building over the load. Perpendicularly below this stringer is another of like construction. Between them is arranged diagonal bracing like ordinary bridging or lattice work either single or double on one side or both of the stringers. This bracing is placed in the meshes of the diamond-shaped openings formed by the lamellas. The two stringers are bolted through from top to bottom at the approximate point of intersection of the lamellas. Thus a latticed girder is formed which spreads the load as far as desired. Overhead monorail systems of 5,000 lb. capacity have been satisfactorily provided for in

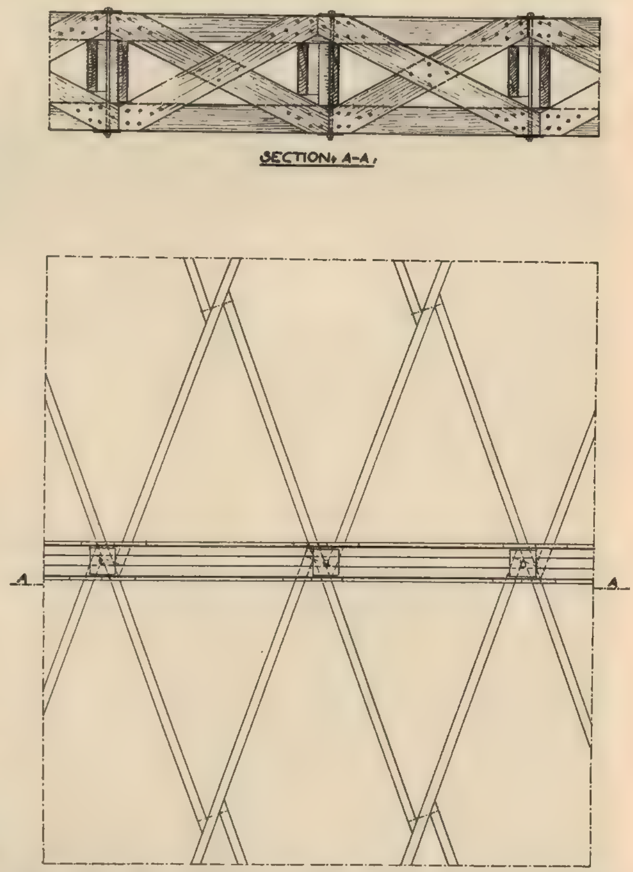


Fig. 23. Method for distributing moderate concentrated loads over several groups of lamellas.

View of St. Louis Arena, Showing Wide, Ur
With Lamella R

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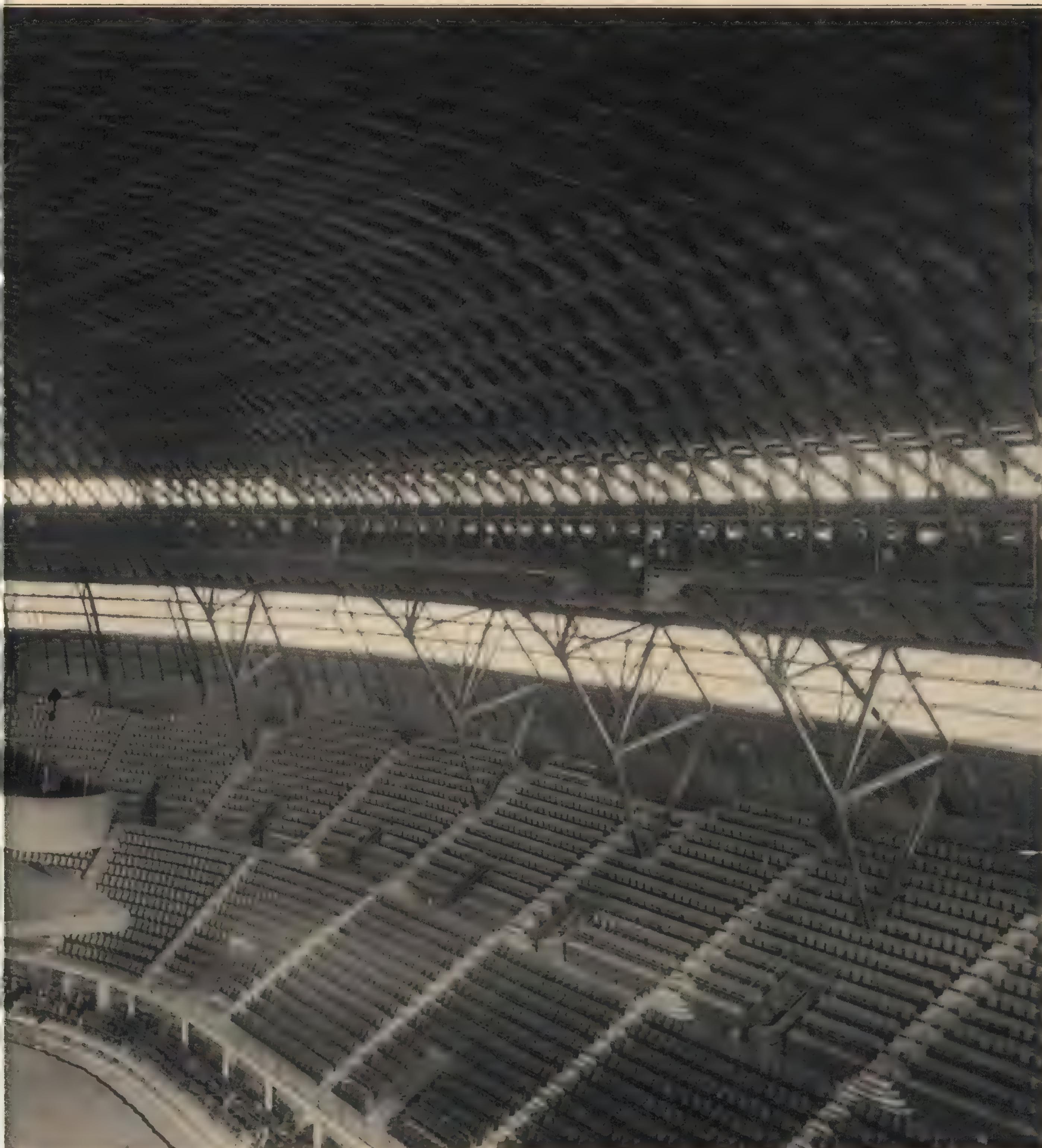

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this manner. This is mentioned merely to suggest a method of providing for moderate loads, but before any definite provisions are made for concentrated loads of any importance it is desirable to consult the nearest Lamella agency.

Erection

Like all arched construction each section of the lamella roof has to be put together piece by piece and held in place until the whole is completed, when the temporary supports may be removed.

Fig. 24. Start of lamella construction, showing first row of lamellas.

The first step in erecting a simple two-hinged arch lamella roof is the installation of the sills. It is not necessary that they be completed from end to end of the building, as the roof may be started at one end as soon as one length of sill is in place on each side.

Fig. 25. Lincoln Market Building, San Diego, Cal., 2 spans 50 feet x 98 feet. This shows clearly the end segments ready to receive the "sloped down rafters."

The next step is the erection of the end segment or semicircular laminated timber that forms one end of the roof proper. This arched piece may be clearly seen in the picture of the Lincoln Market Building, San Diego, California (Fig. 25).

The next step is to set the first row of lamellas, which rest upon the sill, as far as the first tie rod (Fig. 24). These are generally "toe-nailed" in place and the outer edges are rested on temporary ribbands or diagonal supporting struts as indicated in the picture. At a suitable distance from the starting point another ribband is erected, carefully adjusted as to height and the next course of lamellas are erected and bolted into place, resting thereon. By the erection of successive ribbands and the bolting in place of successive groups of lamellas resting on these ribbands the erection, or weaving as it is called, is completed from each sill to a meeting point in the center. When one group or bay of lamellas has been completed the temporary scaffolding may be moved to the next bay. It is unnecessary to go the length of the building with the starting lamellas or with those that

Fig. 26. Seville Theatre, Chula Vista, California. Showing buttresses. Span 50 feet.

are woven together toward the center. Usually it is sufficient to treat as a group or arch unit a section of lamellas between ties. For convenience this unit between ties may be spoken of as a bay.

In the case of the Houston Convention Building, scaffolding the width of one bay was strongly constructed and mounted on wheels and track and moved from end to end of the building as the weaving progressed. If the floor is sufficiently level and smooth, it is possible to put the scaffold-

ing on planks and ordinary rollers and roll it from end to end. Various methods may be adopted according to the ingenuity of the builder and the demands of each individual case.

A careful study of the picture of the skating arena at Ft. Erie, Ontario (Fig. 19), which has a span of 138 feet, one of the largest so far erected on this continent, will reveal the manner in which this scaffolding is arranged to provide for the erection of a bay of lamellas.

At the time the picture was taken one bay had been completed and at both sides another bay had just been started. The temporary ribbands supporting the lamellas are clearly shown. On the left a new ribband is being erected to receive a row of lamellas and at the extreme left two men are erecting starting lamellas. In this manner piece after piece is erected until the arched section of each bay is complete.

On the ground may be seen piles of the lamellas showing the angular end cuts. The curve cut at the top of each lamella to conform to the roof curvature may be clearly seen at the top center of this picture.

When a bay of the roof is completed, the usual procedure is to insert the already assembled tie rod into previously drilled holes in the sills and then to take up on the bolts at the outer ends until

Fig. 27. Westchester County Center, White Plains, N. Y., where the Metropolitan Opera Company performs. This auditorium is 120 ft. wide and 180 ft. long. Its seating capacity is larger than that of the Metropolitan Opera House.

Architects—Walker and Gillette
Consulting Engineer—William Wilson

they are as tight as they can be made by hand, the rod being temporarily supported meanwhile in a straight horizontal position. When the nuts are as tight as they can be made by hand, an extra turn or two is made with a suitable wrench. Thereafter, all of the bolts at the various lamella connections are given a final turn which is usually sufficient to raise the roof slightly off its support, sometimes as much as half an inch. Thereupon the temporary scaffolding may be removed.

Fig. 28. Triangle Investment Corporation's Garage at Orange, New Jersey, under construction. Note segment end pieces and manner in which pier blocks are provided for bearing and to leave sill free to move between ties.

The lumber used for the arch is furnished by local lumber yards and cut by them to the lamella pattern. The cutting is very simple and has often been done with ordinary contractor's equipment, or even by hand, on the building site. Cutting diagrams are furnished by the Lamella companies.

The erection is done in any one of three ways, namely:

(a) By the Lamella companies themselves using local labor and material.

(b) By local contractors with a trained lamella foreman dispatched from the nearest Lamella office.

(c) By local contractors according to standard specifications and instructions of the Lamella companies. Inasmuch as all units usually come to the building site ready manufactured, the erection is an assembly of these units on a movable scaffolding. Experience has shown that the erection of roofs of less than 100 ft. span offers no difficulty for a carpenter foreman who can follow simple blue prints and instructions. Because all the lamellas are cut to one single pattern, uniformity of product and elimination of costly errors are greatly facilitated.

Design Data and Specifications

The foregoing should be sufficient to enable the architect to provide in a preliminary way for the lamella type of roof in his plans. Should he desire more specific and complete information before preparing finished drawings, he should communicate with the nearest Lamella agency which is prepared to submit a definite solution for his problem with appropriate drawings and computations.

The minimum loads for which lamella roofs are designed are those specified by the local building codes. The stress analysis follows standard engineering principles and has been checked and approved by a great number of American and Canadian engineering authorities as well as by

Fig. 29. Riding ring for Sleepy Hollow Country Club, Scarborough, N. Y. Span 90 feet. Architects, Delano & Aldrich. Walls are 22 feet high stiffened by wind buttresses.

the building departments of all principal cities. Designs of the roofs are furnished by the Lamella Roof Syndicate, Inc., or its licensees, as listed on the last page of this bulletin. These companies have been specializing in roof construction for a great many years and furnish suggestions and estimates without obligation.

The usual specification reads as follows:

"The roof structure shall be of the Lamella type and shall be furnished and erected according to the specifications of the Lamella Roof Syndicate, Inc., 45 W. 45th Street, New York, N. Y., or a licensed agency thereof."

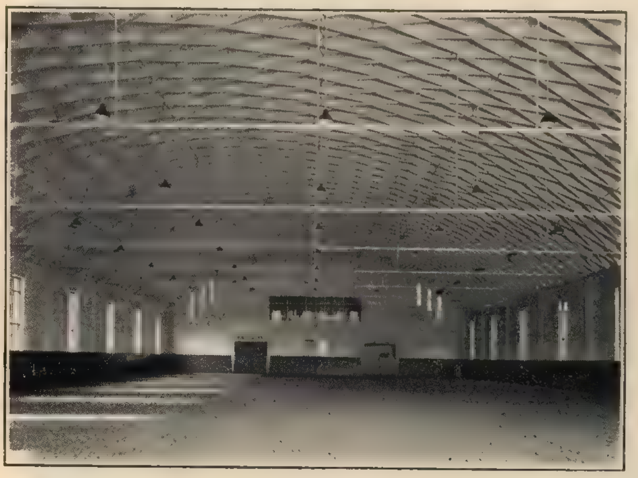

Fig. 30. Interior of Fig. 29—The ceiling is painted with three coats of white.

The following data should be given with inquiries for information:

(a) Kind of building—auditorium, garage, etc.

(b) Location

(c) Width

(d) Length

(e) Height at which roof starts

(f) Material of walls

(g) Thickness of walls

(h) Kind of gutter, parapet or dripover.

(i) Size of piers, if any

(j) Spacing of piers, if any

(k) Type of roof desired (see fig. 15).

(l) Name and address.

For additional technical data see Sweet's Architectural catalog or write to Lamella Roof Syndicate, Inc., or the nearest authorized Lamella construction company.

Fig. 31. Use of tied segmental arch in modern ball room.

Fig. 32. Nave of Church, Church of St. Antonius, Augsburg, Bavaria. Michel Kurz, Architect. The lamella roof has an unusual field of application in the church, where, as illustrated in the above picture, it has demonstrated its adaptability to the Gothic style of architecture.

Fig. 33. Southern Baptist Winter Assembly, Umatilla, Fla. Span 100 feet. Architect, A. T. MacDonough, Eustis, Fla. Thrust is taken up by reinforced concrete portals located in the side aisles.

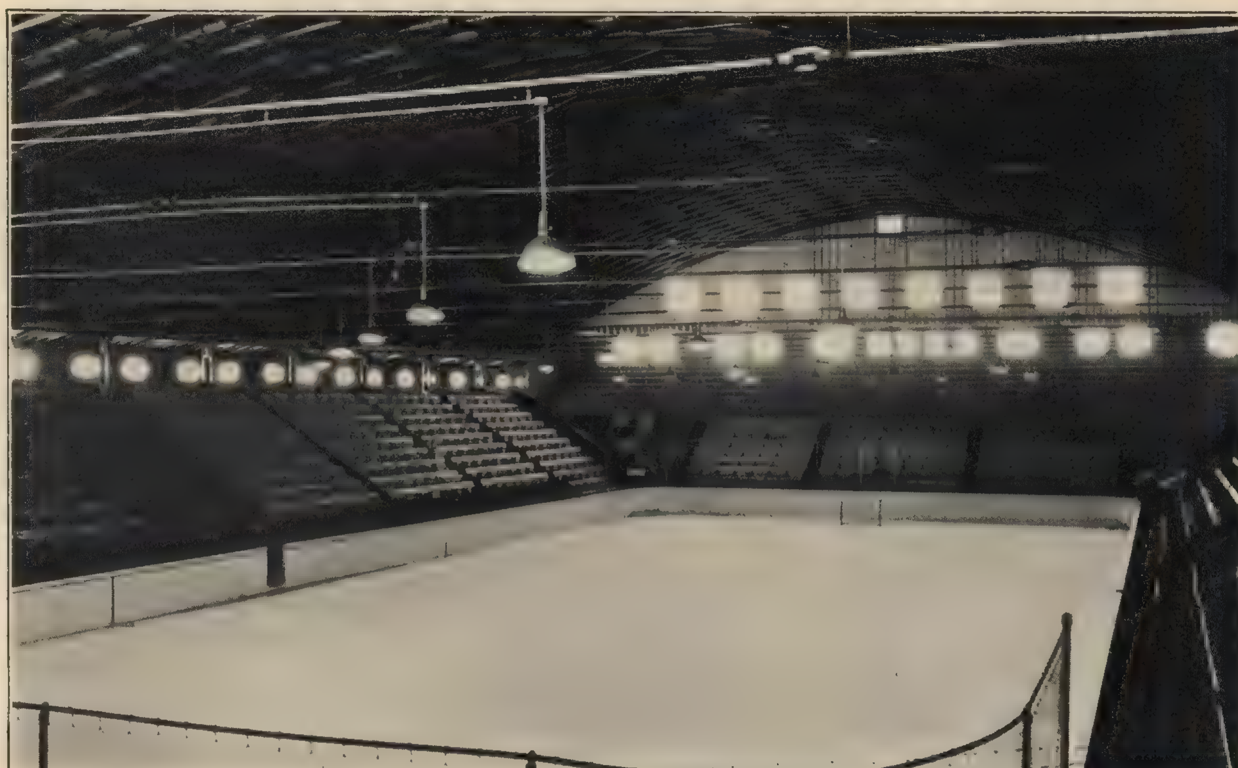

Fig. 34. Hockey Arena, Fort Erie, Canada. Span 138 feet. Architect, F. C. Bodley, Brantford, Ontario, Canada. Note gables, supporting flat roof over end bays. A similar building was erected in Oshawa, Canada.

Fig. 38. Howard Automobile Co. Sales Room, Los Angeles, Cal. This building is 47 feet x 155 feet and illustrates the good lighting to be secured by skylights. It should be noted that the lamellas were left in place, which is desirable, as there is no interference with the structural integrity of the whole. The cutting out of large areas for openings is discouraged as it weakens the structure.

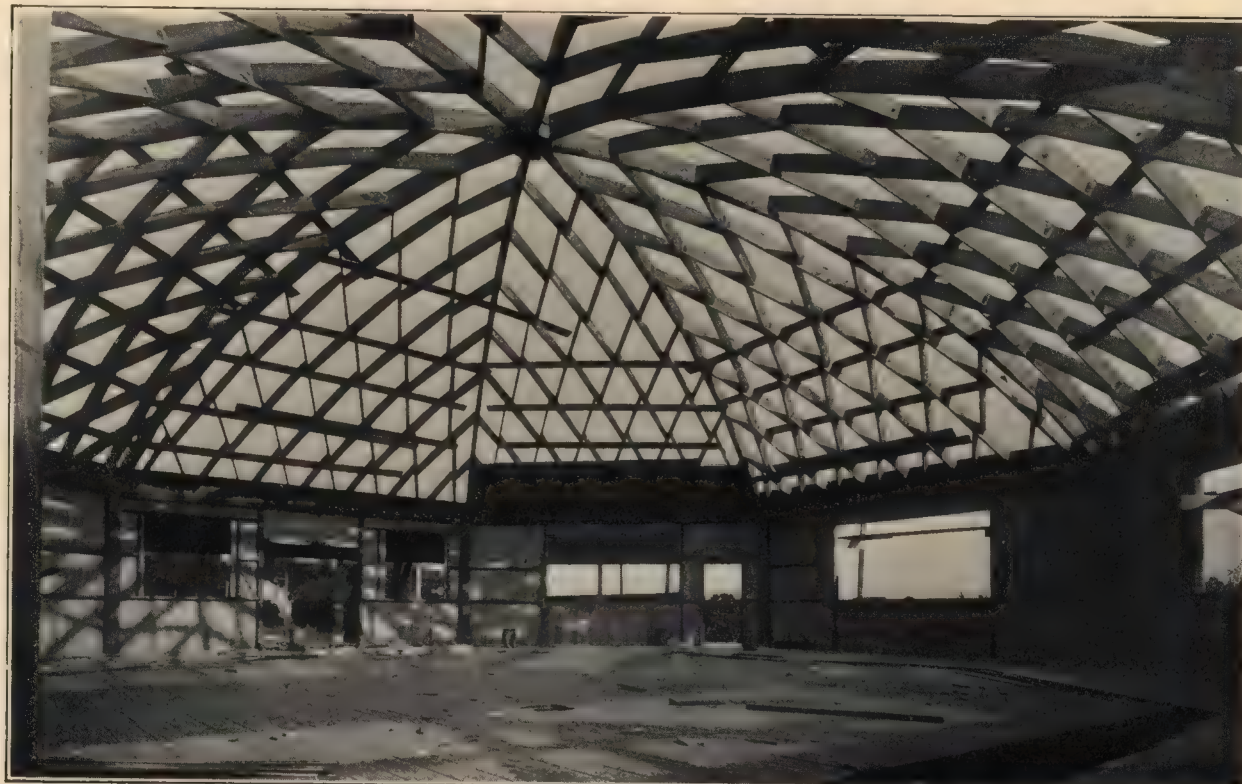

Fig. 36. Dance hall, Shrewsbury, Mass. The plan of this building is an octagon.

Fig. 37. Billiard Room, Santa Barbara, Cal. Span 58 feet. Architects, Edwards, Plunkett & Howell. Rear door of this billiard room leads into a bowling alley, also covered with lamella roof.

Fig. 38. Crane shed of the Weyerhaeuser Timber Company in Everett, Washington. Size 54 feet x 287 feet. It shows the adaptability of this type of roof to use for industrial buildings, including machine shops, warehouses, and the like, where cranes must run the length of the building. While this building is provided with tie-rods to take up the thrust, they might have been omitted and bents substituted without interfering with the use of the wings between bents. Attention is called to the sprinkler system. Insurance rates are very low for this type of construction when provided with sprinklers. In most parts of the country a lamella roof thus protected is stated to receive practically the same rate as reinforced concrete without sprinklers.

Fig. 39. Utilization of lamella in hangar construction.

Fig. 40. Showing strength of lamella construction—wall failure due to cyclone.

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